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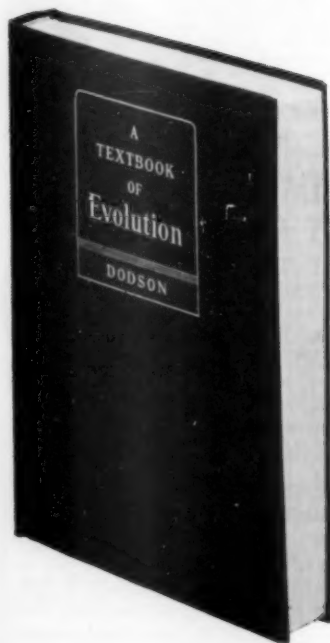
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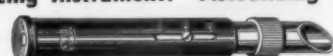
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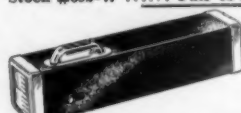
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Monozygotic Twin Beef Cattle in Nutrition Research

A NEW and powerful method of attacking problems that have hitherto defied solution is supplied animal husbandmen by the use of monozygotic, or identical, twin beef animals in growth and nutrition studies. The problem of continuous versus discontinuous growth of beef cattle in relation to the economics of beef production is under investigation at the U. S. Animal Husbandry Experiment Station at Beltsville, Maryland, and data now being obtained with identical twins should lead eventually to the production of more pounds of beef per 100 pounds of expensive concentrate feeds consumed.

Geneticists have estimated that, in nutrition studies, a pair of identical twin calves will yield data equivalent to that otherwise obtainable only with a herd of 40 or more, less closely related, individuals. Because both members of a monozygotic twin pair possess the same inherited characteristics, they respond in the same way to a given nutritional or environmental regimen. One member can thus be subjected to experimental treatment and the other used as a control animal without complications caused by different inherited characteristics. Identical twin calves are rare, however. In the dairy breeds in which twins (both fraternal and monozygotic) occur once in every 49 births, monozygotic twins occur only once in every 1000 births, and monozygotic twins are born in beef herds even more rarely, since twins of both kinds occur only once in 227 calvings.

It is not always easy to determine whether a given pair of twins is monozygotic, since fraternal twins often appear very much alike, especially at an early age. Identical twinning is established by differences rather than similarities in the two individuals, and a blood test can be used for confirmation, although it is not entirely reliable. The test is based upon antigenic

characters in the blood, and if used in conjunction with critical examinations of co-twins, it is the best method now known for determining which twins are identical.

The Beltsville experiments are the first on record in which identical twin beef calves have been used. However, monozygotic twins of the dairy breeds were used at the Animal Breeding Institute at Wiad, Sweden, 14 years ago, and are now being used at experiment stations in the U. S. A., England, New Zealand, and in some European countries.

Although the growth studies at Beltsville have been in progress less than three years, they already suggest that the loss of efficiency in the conversion of feed materials and the difficulty exhibited by growing animals in recovering from the effects of interrupted growth under range conditions, originate in protein, mineral, or vitamin A deficiencies rather than in a deficiency of feed energy. Results obtained with the first six pairs of identical twins have shown that beef animals fed a ration at the maintenance level with regard to energy value, but otherwise adequate for growth, and on which they were unable to gain weight from the age of six months to one year, remained healthy and were able, when given full rations, to make gains as rapidly and as economically as their twin brothers that had been fed adequate rations throughout the experiment. The meat of the animals that had received the low-calorie rations was found to be equal to that of the well-fed animals by every test to which it was subjected. With only one exception, both members of each pair reached the slaughter weight of 1000 pounds within about three months of the same time.

Ten additional pairs of identical twin beef animals are currently being subjected to experimental treatment at Beltsville.

C. F. WINCHESTER

*Animal Husbandry Division, Bureau of
Animal Industry
USDA Research Center, Beltsville, Maryland*

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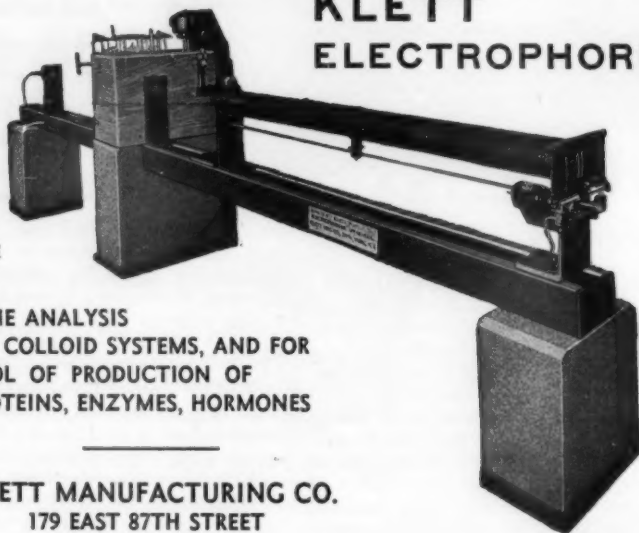
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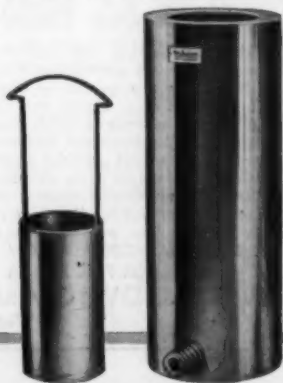


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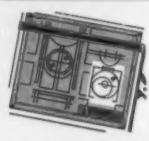
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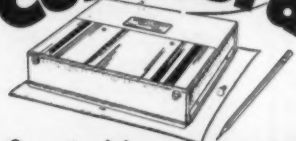
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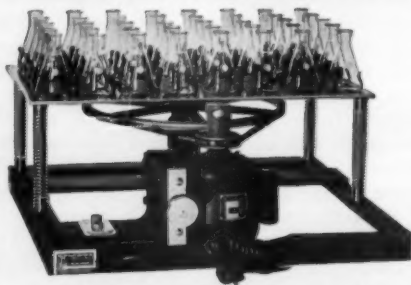
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The Scientific Council on Problems of the Physiological Theory of Academician I. P. Pavlov: A Study in Control

Ivan D. London

Russian Research Center, Harvard University, Cambridge, Massachusetts

EVEN IN THE SOVIET UNION it is one thing to decree the ideological line for the several sciences, and another thing to implement, interpret, and enforce it. Falling into the Party line is not an automatic affair and poses, moreover, difficulties even for the scientist who wants to conform: He is never quite sure whether he is following the line as intended or as *will be* intended—whether he is underadhering or overadhering. The many publicized instances of displeasure feed and justify his apprehensions. But he continues to try to operate within the limitations imposed from above and to salvage what he can—that is, unless he has abased himself to the equivalent of a Party hack. There are very, very many of these.¹

The scientific council, which the presidium of the USSR Academy of Sciences set up to act as a watchdog over physiological and related research, provides through its published decrees some insight into the manner of holding scientists to adopted lines. From these decrees, with their sometimes inquisitorial language, one surmises also the private drama of those persons unfortunate enough to have been singled out as symbols for public ire, as well as the drabber problems of the routine, pedestrian researcher.

This council, known in full as the Scientific Council on Problems of the Physiological Theory of Academician I. P. Pavlov (Affiliated with the Presidium of the USSR Academy of Sciences), was established in 1950 under charge by the joint assemblage of the USSR Academy of Sciences and the USSR Academy of Medical Sciences to facilitate and guarantee the Pavlovianization of physiology and related disciplines. Its chairman is the same Bykov who, along with Ivanov-Smolenskii, had come to head the newly formed Pavlovian front (1).

Since its inception, according to the available literature, the Scientific Council has been called into session at least six times. Its activities, although little publicized, are nevertheless clearly reflected in its decrees, some of which are documents of considerable human interest.

The first meeting of the Scientific Council took place in Moscow, October 13–14, 1950. A variety of questions was taken up for discussion: Bykov spoke

of the “principal tasks of the Council;” a second edition of the complete works of Pavlov was proposed; and so forth. But the chief items on the council’s agenda were the research plans submitted by Airapet’iants, Asratian, and others for the year 1951. Although these plans were the subject of detailed discussion, there was never really much doubt that the official seal of approval would be theirs—Airapet’iants and Asratian had long been playing pro-Pavlovian roles of some prominence, and Airapet’iants was, moreover, secretary of the Scientific Council (2).

The second meeting took place December 25–27, 1950. Bykov detailed the progress that had been made toward “realization of the decrees of the joint session of the USSR Academy of Sciences and the USSR Academy of Medical Sciences.” Kupalov presented his plans for the organization of a “scientific session” to commemorate the anniversary of Pavlov’s death. Ivanov-Smolenskii discussed what went into readying for publication the new journal—*Zhurnal Vyssheĭ Nervoĭ Deiatel’nosti Imeni I. P. Pavlova* (*The Pavlov Journal of Higher Nervous Activity*)—decreed to be established by the “joint session” of six months before, and scheduled for first issue in January 1951. The research plans of Speranskii, Kupalov, and others were presented and discussed. Finally, Asratian was unanimously voted honorary lecturer for the “Pavlovian Readings” of 1951, with Kiev designated as the place of the next lecture (3, 4).

The calm and matter-of-fact reporting of the first two meetings of the Scientific Council creates an impression of harmonious concurrence among Pavlovians—the old and the new—which the third and fourth meetings sharply belie. On keeping to slogans and verbal stereotypes, it is true, all manage to be properly Pavlovian. On getting down to the real business of theory and experiment, however, the oneness of scientific faith may be seen for the false façade that it is. Orbeli and Beritov, for example, may affirm day after day their Pavlovian orthodoxy, but they seem always somehow to stay out of step, no matter how hard they try to go along (5, 6). As a matter of fact, just this discrepancy between actual practice and outer appearance is the *raison d’être* of the Scientific Council itself. The council is an agency of control both to give direction and to correct any erroneous course.

¹Two sources contribute to this interpretation: the literature of the Soviet scientific and public press itself, and the interviews conducted both here and in Germany by the Harvard Refugee Interview Project (now termed Harvard Project on the Soviet Social System), of which the writer is a member.

On April 10-12, 1951, the Scientific Council was again called into session, for the third time since its constitution. This session was indeed dramatic. Beritashvili (Beritov), the lone hold-out over the years against a Pavlovian physiology of higher nervous activity, was called to Moscow from Tbilisi (Tiflis) in Georgia to explain his stubborn deviationism. His attempts at defense were a foredoomed futility. His audience was "properly" hostile. It remained only to cap this man-sullyng business with the inevitable recantation, and this Beritashvili did.²

The human story breaks through the cold censoring words of the "Decree of the Scientific Council on Problems of the Physiological Theory of Academician I. P. Pavlov, April 12, 1951" (8, 9), the translation of which is here given:

DECREE

In its session of April 10-12, the Scientific Council listened to Academician I. S. Beritashvili's paper, "On the Factual and Methodological Bases of Reflex and Behavior Theory," and to his elucidation of views [contained therein]. The Scientific Council considered the questions posed in the paper and in the [following] discussions.

There took part in the work of the session leading specialists in the fields of physiology, psychology, and philosophy who unanimously censured Academician Beritashvili's [whole] conception.

The essence of I. S. Beritashvili's [theoretical orientation and] set is reducible to a series of vicious affirmations:

1) There exists a special "psychonervous activity," so-called by him, which [represents] a stage higher than that of higher nervous activity;

2) The reflex principle is not extensible to this "psychonervous activity;"

3) Animals that possess a cerebral cortex are directed in their behavior by "ideans" (analogous to those of man);

4) In [real] fact, the attempt to create on this vicious foundation a special science of behavior is being continued;

5) In I. S. Beritashvili's [whole] conception there is being repeated his former [attempted] revision of the basic lawful regularities of higher nervous activity which were established by I. P. Pavlov.

The Scientific Council states that Academician I. S. Beritashvili to this very day holds on to anti-Pavlovian positions and that his [present] inclination to make use of Pavlovian terminology does not put aright the essence of his [fundamental] conception but, contrariwise, is a form of veiling the reactionary and pseudoscientific theses of Academician Beritashvili. By means of his erroneous views Academician Beritashvili tries to throw back native physiology to pre-Pavlovian times.

[Viewed] fundamentally, in Academician I. S. Beritashvili's paper there is expounded the dualist and idealist conception of his so-called "psychonervous activity," which was [already] contained in his brochure, "Bases of Nervous and Psychonervous Activity" (1947).

The Scientific Council holds:

1. Academician I. S. Beritashvili's [whole] conception

²The date of Beritashvili's official recantation was erroneously given as May 23, 1951, in an earlier paper (7).

is a frank dualism and contradicts in principle I. P. Pavlov's consistently materialist theory of higher nervous activity.

2. Academician I. S. Beritashvili is in manifest contradiction with the resolutions of the Joint Session of the USSR Academy of Sciences and the USSR Academy of Medical Sciences.

3. Academician I. S. Beritashvili, in his argumentation about spontaneous activity of nervous elements, forsakes in the field of physiology the strictly deterministic position, on which I. P. Pavlov's entire materialist theory is based.

4. Academician I. S. Beritashvili has taken to the road of scientific speculation, creating utterly unfounded hypotheses about cortical processes and replacing the objective analysis of higher nervous activity in animals with divinations of their subjective states.

5. The facts with which Academician I. S. Beritashvili operates are, in a number of instances, [of] doubtful [character] and demand a careful objective analysis from the standpoint of Pavlovian physiology.

6. Since the time of the Joint Session there has been effected in the views of Academician I. S. Beritashvili no essential changes whatsoever [which may be thought of as] drawing them nearer to Pavlovian physiology.

The Scientific Council regards as improper [the fact] that the resolutions of the Joint Session were not only not put into force by the leadership of the Georgian Physiological Institute, but also that no broad discussion of the resolutions was organized in the Institute.

Academician I. S. Beritashvili's anti-Pavlovian views are a serious ideological obstacle to the development of physiological research in Georgia along Pavlovian lines.

The Scientific Council considers that in a number of Georgian physiological institutions, an intolerable Arakcheevian regime [with its favoritism, toadyism, and aridity] has entrenched itself—a regime in which criticism of I. S. Beritashvili's views was forbidden and where those scientific workers who did express [well]-founded objections against his anti-Pavlovian [orientation and] tendencies were persecuted [and ran out]. Arakcheevian methods were especially widely practiced by Prof. Narikashvili, deputy director of the Georgian Academy of Sciences' Institute of Physiology.

The Scientific Council also censures I. S. Beritashvili's contemptuous attitude toward the accomplishments of native physiology and censures his cosmopolitan worship of foreign science.

The Scientific Council considers it necessary that, in one of its sessions in the near future, it discuss the plan of scientific work of the Georgian Academy of Sciences' Physiological Institute.

The Scientific Council considers it necessary to dispatch to Tbilisi an authoritative commission of physiologists in order to organize and conduct a broad discussion of Academician I. S. Beritashvili's errors.³

The Scientific Council takes notice of Academician I. S. Beritashvili's declaration that the criticism directed his way is correct, that he recognizes the idealist essence

³On May 23, 1951, a repeat performance on a smaller scale took place as ordered. Narikashvili first rendered an account of the April proceedings of the Scientific Council in Moscow. Then Beritashvili's fateful paper was discussed and heckled. A resolution was passed condemning his views. Narikashvili announced that the "collective of the Institute of Physiology of the Georgian Academy of Sciences would draw the necessary conclusions from the just criticisms of the erroneous conceptions of Academician Beritashvili." Finally, Beritashvili again "acknowledged as correct the criticism of his scientific views" (10, 11).

of his "conceptions," and that he desires to rectify his anti-Pavlovian, idealist errors.

(Confirmed by the Presidium of the USSR Academy of Sciences, April 13, 1951)

The Scientific Council was convened for the fourth time early in June 1951. One of its decrees, dated June 6, 1951, considers the research plans of Fol'bert and Protopopov, both from the Ukraine (12, 13); another deals with Orbeli (14-16).

Fol'bert and Protopopov are congratulated for presenting "[research] plans [that] are directed toward further development of the ideas of I. P. Pavlov in the field of physiology and medicine." However, their tendency, along with others, to skirt the central problems of Pavlovian theory in favor of peripheral or "associated problems" is condemned. These researchers are therefore advised in the future to direct their attention to the key issues of research on higher nervous activity. In addition, certain conceptual formulations by Fol'bert and Protopopov undergo criticism. The decree notes and affirms that "the requisite clarity in the formulation of such concepts as fatigue, exhaustion, and inhibition is wanting in both the [research] plan and statements of Prof. I. U. V. Fol'bert," and that "similarly there is a noticeable lack of clarity in the formulations [to be found both in the research] plan and in the statements of Prof. V. P. Protopopov concerning the problem of habit and symbols in the study of higher nervous activity in animals." These two researchers are also admonished to bring their investigations into line with practical needs, even as they engage in fundamental research. Thus, "the Council recommends to Prof. I. U. V. Fol'bert that he tie his investigations more closely to the tasks of medicine and physical education." How he is to do this and not skirt the central problems of Pavlovian theory in favor of "associated problems" is not indicated. The decree finally approves with reservations the submitted plans of research.

Orbeli, once a figure of importance and power in the Soviet scientific world, is confirmed in the ignominy of his present low state by the decree of the Scientific Council of June 6, 1951. Unsented and discredited by Lysenko and undermined further during the Pavlovian sessions by Bykov (17), Orbeli is here treated almost like a little boy who hasn't done his homework right. Orbeli's degradation cannot be better revealed than in the words of this decree.

DECREE

The fourth session of the Scientific Council listened to and discussed the plan of scientific research work of the physiological laboratory of the Lesgaft Natural Science Institute, affiliated with the RSFSR Academy of Pedagogical Sciences, and of the physiological groups headed by L. A. Orbeli in 1951. The Scientific Council listened to and discussed the declaration to it of Academician L. A. Orbeli concerning his attitude toward criticism of his theoretical errors, reflected in the decree of the Joint Session of the USSR Academy of Sciences and the USSR Academy of Medical Sciences in 1950.

The declaration, presented by Academician L. A. Orbeli

to the Scientific Council, as well as his explanations and answers to questions arising in the course of the discussion, cannot be deemed satisfactory.

The Scientific Council observes that Academician L. A. Orbeli only formally acknowledges the criticism directed against his views in the Joint Session, all the while essentially holding on to his former anti-Pavlovian positions.

In trying to excuse the errors committed by him, Academician L. A. Orbeli has turned to [traveling] the inadmissible road of discreditation of the views of the founders of [our] native materialist physiology, I. M. Sechenov and I. P. Pavlov. Academician L. A. Orbeli has distorted generally known facts; has denied the presence of a consistent materialist system of views in the works of I. M. Sechenov and I. P. Pavlov; has tried to represent I. P. Pavlov as an empiricist, standing aside from the struggle of materialism with idealism and ostensibly supporting idealist subjective method in the physiology of higher nervous activity. Academician L. A. Orbeli, in trying to explain away [those] errors of his [which reveal a pro-Morganist bias in behalf of] formal genetics, has striven to soft-pedal the implacable struggle of I. P. Pavlov with Morganism.

On questions of principle Academician L. A. Orbeli steered away from direct replies and tried, essentially, to shed from himself responsibility for the ideological and organizational errors committed by him.

The plan [of research] which has been presented is devoted to exploration of the second signal system⁴ without [any] indication of the physiological methods [to be employed], and his [proposed] investigation of the sympathetic nervous system is limited to [only] one theme. The absence of [any] concrete [indication of the] physiological means [to be employed in the] experimental investigation of the most difficult problem of the second signal system in its interaction with the first [signal system], along with the limited character of the experiment itself in this area, and the presence of methodological errors, unextirpated by Academician L. A. Orbeli, cannot guarantee a successful conclusion to such a plan [of research].

The Scientific Council considers the plan of scientific work, submitted by Academician L. A. Orbeli, as unsatisfactory and recommends that the plan be subjected to thorough revision.

The Scientific Council recommends that Academician L. A. Orbeli [continue to] pursue his research on the physiology of the sympathetic nervous system on condition that he eliminate his errors, committed in the [long] course of working over this [research] problem and [that he pursue his research] on the basis of the general principles of Pavlovian physiology in close conjunction with the problems of the clinic.⁵

The Scientific Council thinks that investigations of the physiology of higher nervous activity in man can be car-

⁴ Briefly, in Pavlovian theory the second signal system substitutes verbal cues for the physical stimuli that the first signal system employs. The conditionability of both verbal and physical stimuli permits them the role of signals.

⁵ After his exhortation during the Pavlovian sessions of 1950 because of his alleged "preoccupation with the sympathetic nervous system to the exclusion of its subordinate connection with the cerebral cortex," Orbeli evidently felt that the expedient course of action was to quit major study of the sympathetic nervous system. *Pravda*, however, put it as follows: "Not desiring to revise the erroneous principles [employed by him] in [his] conception of the sympathetic nervous system, which he studied without taking into account the predominant role of the cerebral cortex, Academician L. A. Orbeli has hit the road to renunciation of further research on these problems . . ." (18).

ried out [successfully] in the laboratory headed by Academician L. A. Orbeli only on condition that Academician L. A. Orbeli radically revise the methodological principles [applied by him to] these problems and that he select suitable qualified specialists [to make up his laboratory personnel].

The Scientific Council takes notice of Academician L. A. Orbeli's announcement that he is in full agreement with the criticism directed against his views in the Joint Session of the USSR Academy of Sciences and the USSR Academy of Medical Sciences and in the fourth session of the Scientific Council, and [also] that he promises in his future work to correct committed errors.

(Confirmed by the Presidium of the USSR Academy of Sciences, June 15, 1951)

In view of the responsibilities and scope of the work of the Scientific Council on Problems of the Physiological Theory of Academician I. P. Pavlov, it is difficult to believe that it has the time to handle its work load and come to decisions in the course of its scheduled meetings: four within nine months. The monitoring of research and browbeating of dissidents such as Beritashvili and Orbeli must, by any realistic view, take place, in the main, between meetings. These meetings are best viewed, it would seem, as primarily of formal character, officially approving prior decisions and not hesitating to stage a simulated freedom of discussion where "education" and example are desired for broader purposes.

Aside from the internal evidence of the decrees already noted, further evidence in support of this conclusion may be adduced from the following:

1) *The 14th Conference on Problems of Higher Nervous Activity, Dedicated to the 15th Anniversary of Academician I. P. Pavlov's Death.* This conference was organized by the Scientific Council and was held in Moscow on April 5-8, 1951, prior to its third session held on April 10-12, 1951. The decree of the 14th Conference, dated April 8, 1951, and confirmed by the Presidium of the USSR Academy of Sciences on April 13, 1951, bears the signatures of Bykov and Airapet'iants, chairman and secretary, respectively, of the Scientific Council (19, 20).

2) *The decree of the Scientific Council, dated September 26, 1951.* This decree was issued during its fifth session and refers to "information [supplied to it] by M. A. Usievich, a council member, concerning the state of affairs as regards the development of the physiological theory of Academician I. P. Pavlov in the city of Rostov-on-the-Don . . . [at the hands of] N. A. Rozhanskii [who is properly criticized by Usievich for his] methodologically erroneous conceptions" (21, 22). The decree also cites with approval the attack on "Rozhanskii's perverted views" published by Usievich on July 8, 1951, in *Meditinskii Rabotnik (The Medical Worker)* (23).

3) *The decree of the Scientific Council, dated November 24, 1951.* This decree, issued during its sixth session, takes Anokhin severely to task for his continued adherence to "anti-Pavlovian positions" despite profuse protestations to the contrary (24) and adamantly affirms that "the Scientific Council considers

it necessary to dispatch a representative of the Scientific Council to Riazan' [where Anokhin heads the Department of Physiology in the Riazan' Medical Institute] in order to conduct discussions on the results of the sixth session of the Scientific Council on Problems of the Physiological Theory of Academician I. P. Pavlov and in order to render assistance to the directorate in revising the work of the Pavlovian Committee of the Riazan' Medical Institute" (25).

4) *The 15th Conference on Problems of Higher Nervous Activity, Dedicated to the 50th Anniversary of Academician I. P. Pavlov's Theory on Conditioned Reflexes.* This conference was organized by the Scientific Council and was held in Leningrad on April 2-6, 1952. Members of the council contributed papers, several of which were subsequently published (26-28).

5) *The coreports (sodoklady) of the Committee of the Scientific Council.* Volokhov, a member of the editorial board of the *Fiziologicheskii Zhurnal SSSR (USSR Physiological Journal)*, in rendering an account of the sixth session of the Scientific Council for the *Vestnik Akademii Nauk SSSR (Bulletin of the USSR Academy of Sciences)*, alludes three times to the coreports of a committee of the Scientific Council—the first public mention of the existence of which the writer has happened upon (29). According to Volokhov, these coreports are given after the presentation of past activities and future plans by those individuals who have been called upon to render an account of themselves as responsible heads of various physiological programs—research, pedagogical, etc. These coreports reflect investigative action between council sessions and, because of their scope and technical nature, must surely have been submitted, prior to public presentation, to the various members of the Scientific Council in a private and more detailed version.

6) *The critical articles appearing in the scientific and public press, written or inspired by members of the Scientific Council (30-39).* The publication dates of these articles and those of the decrees of the Scientific Council bear more than an accidental relationship. There is much evidence of coordinated activity. The membership of Bykov, Airapet'iants, and Usievich—all of the Scientific Council—on the editorial board of the *Journal of Higher Nervous Activity* is certainly not without significance in this connection, as is also the presence, on the Committee of the Scientific Council, of members of the editorial board of the *USSR Physiological Journal* (e.g., Chernigovskii).

The mission of the Scientific Council is to ensure the Pavlovianization of physiology in the spirit of *partiinost'*.⁶ This it is busily doing. This also is, to be sure, an unfortunate development for world science. Whether this retrogression, however, represents a total loss to world science should not be answered in the glib affirmative, at least not for the present. The literature recording developments may be discouraging, but we must wait for fuller reports of the theo-

⁶ A difficult term to translate; probably best rendered as "Party partisanship."

retical and experimental efforts instigated by this old-new doctrine that has been adopted as the only basis for a "truly materialist, progressive physiology." In spite of unsophisticated theory, interesting developments sometimes emerge.

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News and Notes

The Radiation Research Society

DURING the past fifty years the complexity of science has increased enormously and has led to greater specialization. This is reflected by the formation of numerous scientific societies and the establishment of subdivisions in the older societies, all of which, in the opinion of the respective members, serve a useful purpose. However, specialization carried too far may well have an adverse effect on the progress of science.

Although specialization cannot be avoided, its harmful consequences may be mitigated by taking advantage of another trend in modern science. The solution of many important problems requires the collective effort of specialists in different fields. Therefore, if a *problem*, instead of a branch of science, is made the common point of interest, it is possible to bring together specialists from different disciplines. Contacts among such specialists would then broaden their views and would be beneficial to all. The study of the biological effects of radiation is an ideal problem of this type, in that it involves the collaboration of physicists, chemists, and biologists. This idea has led to the formation of the Radiation Research Society, which held its first business meeting in New York on April 15, 1952.

The new society is perhaps unique in that it is expressly constituted to bring together scientists of widely different backgrounds in a highly specialized field—on a perfectly equal basis. To this end, its constitution stipulates that: "The Council shall consist of the Officers and 10 elected Councillors. The fields of physics, chemistry, biology and medicine shall be represented on the Council each by two Councillors, elected expressly for this purpose. The remaining two Councillors shall be elected to represent science in general."

The objects of the society are purposely quite broad: "(1) To promote original research in the natural sciences relating to radiation. (2) To facilitate integration of different disciplines in the study of radiation effects. (3) To promote the diffusion of knowledge in these fields."

The interest shown in the society augurs well for its success. Practically all those invited to become members joined, and the initial membership is over 250. The officers for the year 1952-53 are: Raymond E. Zirkle, president; Alexander Hollaender, vice president; Abraham Edelmann, secretary; Harvey Patt, treasurer.

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Scientists in the News

Daniel I. Arnon, professor of plant physiology in the University of California at Berkeley, has been elected President of the American Society of Plant Physiologists.

Brewton Berry, professor of sociology at Ohio State University, has received the \$1000 Anisfield-Wolf Award for his book *Race Relations*, published by Houghton Mifflin Company. The volume is the first textbook to receive one of the awards, which were established 18 years ago by Edith A. Wolf, of Cleveland, in memory of her father and her husband. The awards—two each year—go to the best books dealing with problems of racial and nationality group relations. Members of the Awards Committee were Ralph Linton, of Yale University, Henry Seidel Canby and Amy Loveman, of the editorial staff of *The Saturday*

Review, and Henry Pratt Fairchild, of New York University. Dr. Berry has been an Ohio State faculty member since 1946.

Wesley Bourne, until recently professor and chairman of the Department of Anaesthesia of McGill University, has accepted an offer from WHO to act as counselor in the setting up of a center in Paris, to provide training in anesthesia for graduates in medicine. The term of his engagement will be from November 1952 to the end of 1953.

In recognition of their outstanding contributions to engineering and science, honorary degrees were conferred on **Albert Caquot**, president of the International Standards Association and president of the French National Academy of Arts and Sciences, and **Edwin Herbert Land**, president of the Polaroid Company and of the American Academy of Arts and Sciences, by the Polytechnic Institute of Brooklyn. Dr. Caquot is professor at the Ecole des Ponts et Chaussées. Dr. Land is the inventor of the Polaroid camera.

A. Kennon Davis, instructor in physiology at the University of Tennessee Medical Units in Memphis, has joined the staff of the U. S. Naval Radiological Defense Laboratory in San Francisco, to do research on thermal burns that may be received from an atomic explosion.

Hans Frauenfelder, nuclear physicist at the Swiss Federal Institute of Technology in Zurich, will join the staff of the University of Illinois.

A *Festschrift* on the 70th birthday of **Richard B. Goldschmidt**, University of California, has been published by the *Portugaliae Acta Biologica*. It contains contributions from 30 authors, representing 11 countries.

Avram Goldstein has returned to Harvard Medical School as assistant professor of pharmacology, after a year at the Pharmacological Institute of the University of Bern.

Leon Gordon and **Ira G. Wool**, medical students at the University of Chicago, have been awarded the Harry Ginsburg memorial prize for 1952. Awarded to medical students in the department of physiology, the prize is a tribute to the late Harry Ginsburg, who died while a student at the university. Dr. Gordon, who received his M.D. with honors in physiology, will interne at Philadelphia General Hospital. Mr. Wool is a junior in medical school.

Eleanor Hudson Grady, dean of faculty at Hunter College, has announced her retirement effective next February. Dr. Grady, who has been associated with the college since 1915, will be on a leave of absence during the fall semester. Appointed dean of faculty in 1941, Dr. Grady served as acting president of the college during 1950-51 while **George Shuster** served as Land Commissioner in Bavaria. Last year she was voted the "Woman of the Year in Education" by

the New York Chapter of the American Association of University Women.

G. Halsey Hunt has been appointed an assistant surgeon general of the Public Health Service and will serve as associate chief of the Bureau of Medical Services. Dr. Hunt was formerly chief of the Division of Hospitals. The Bureau of Medical Services administers most of the PHS direct medical care functions, managing 22 hospitals located in major seaport cities and over 100 outpatient facilities. The bureau also includes the Division of Foreign Quarantine, divisions concerned with medical, hospital, dental, and nursing resources, and is responsible for the administration of the Hospital Survey and Construction Act. Dr. Hunt joined the Bureau of Medical Services as assistant chief of the Division of Hospitals in 1947, becoming chief in 1949, succeeding **Otis L. Anderson**, now chief of the Bureau of State Services.

Gerald Klatskin, associate professor of medicine at Yale, has received the first Francis Gilman Blake Award, established by the Yale chapter of Nu Sigma Nu, a medical fraternity. The award is named after the late Dr. Blake, former dean of the Yale School of Medicine, who died last February. In establishing the award, the students announced that the purpose was to encourage better teaching of the medical sciences by recalling the example set by Dr. Blake. The recipient will be chosen annually by a vote of the entire graduating medical class, and a permanent plaque with the names of the Blake Award winners will be hung in the school.

The American Association of the History of Medicine has awarded the William Osler medal for 1952 to **Herbert S. Klickstein**, a fourth-year student at the University of Pennsylvania School of Medicine, in recognition of his essay on "A Short History of the Professorship of Chemistry of the University of Pennsylvania School of Medicine."

Frank V. Kosikowsky, of Cornell University's Dairy Department, has accepted an FAO invitation to participate in a symposia and refresher course on cheese manufacturing to be held in Poligny, France, Sept. 8-13. The meeting will be held in cooperation with the International Dairy Federation.

John W. Marden, Westinghouse research scientist, has received from the Department of the Army its highest civilian award in recognition of his research and development of a new alloy for barrel liners for automatic weapons. Dr. Marden has been working on the development of this new metal since 1942.

N. T. Mattox has resigned his position at the University of Puerto Rico to accept an appointment at the University of Southern California, where he will serve as half-time research associate in the Allan Hancock Foundation for marine studies and half-time as associate professor in zoology.

F. Lloyd Mussells has been appointed executive

director of the Committee on Medical Sciences, Research and Development Board, Department of Defense. Dr. Mussells, who has served as deputy executive director since July 1951, succeeds **Thomas B. Spencer**, who will join the staff of the Cornell Medical Center in New York City as director of the Out-Patient Department of the New York Hospital and as Instructor in Medicine at the College of Medicine, Cornell University. Dr. Mussells is on a two-year leave of absence from Strong Memorial Hospital, University of Rochester, where he was assistant director from 1949 to 1951.

S. M. Naudé, vice president of the South African Council for Scientific and Industrial Research, is visiting the U. S. and Canada during June and July to renew his contacts in North America with directors of a number of research organizations, after a similar tour of the United Kingdom and the continent. Dr. Naudé was director of the South African National Physical Laboratory and a former professor of Physics at the University of Stellenbosch.

W. Albert Noyes, Jr., chairman of the University of Rochester Chemistry Department and former president of the American Chemical Society, has been appointed dean of the University's Graduate School. **Lewis W. Beck**, chairman of the Philosophy Department, has been named to the new position of associate dean. Both men will continue as chairmen of their departments. Dr. Noyes succeeds **Frank P. Smith** as graduate dean. Dr. Smith has resigned to become director of the Bureau of Business Research and professor of business administration at the University of Michigan. Dr. Noyes is senior scientific adviser to **Anthony C. McAuliffe**, chief of the U. S. Chemical Corps, and is also chairman of the NRC Division of Chemistry and Chemical Technology, a member of the Naval Research Advisory Committee, and consultant to the Atomic Energy Commission.

John Frederick Reinhard has been appointed director of pharmacologic research in the Warner Institute for Therapeutic Research. Dr. Reinhard formerly was director of the Pharmacology Department, Nepera Chemical Co. He has served as a member of the staff of New York University College of Medicine and Dentistry, as well as pharmacologist at the Wellcome Research Laboratories.

R. H. Simpson, meteorologist in charge of the Honolulu weather bureau and secretary of the Standing Committee on Pacific Meteorology, left Honolulu at the end of May to take a position in the central office of the Weather Bureau in Washington, D. C. Mr. Simpson's work will be concerned with the planning and development of the bureau's scientific and research activities.

Esmond E. Snell, University of Texas biochemist, is in Europe to attend the second International Congress of Biochemistry, before which he will discuss his research on the ways in which aureomycin increases use of vitamin B₆ in the body, the part the

vitamin plays in body functions, its distribution in nature, and its relation to the growth of lactic acid bacteria.

Henry Terrey has been appointed to the University chair of chemistry at University College, London.

John L. Wood, professor of chemistry, University of Tennessee Medical Units, has been appointed head of the Department of Biochemistry. **T. P. Nash, Jr.**, dean of the School of Biological Sciences and chief of the Division of Chemistry, will continue as dean and chief of the division. Dr. Wood will assume major responsibility for the instruction of undergraduate and graduate students in biochemistry.

Education

Le Bonheur Children's Hospital, the only general practice hospital exclusively for children in the Mid-South, opened June 25 in Memphis. **J. Caffey, A. Christie, H. W. K. Dargeon, J. H. Hess, L. D. Baker**, and members of the staff of the University of Tennessee College of Medicine participated in a two-day seminar in celebration of the occasion. The \$2,000,000 hospital was built with funds provided by the federal government under the Hill-Burton Act, the state of Tennessee, and money raised by Le Bonheur, Memphis women's philanthropic organization.

Brookhaven National Laboratory will be host to 63 visiting scientists and 91 students this summer, who will participate in the laboratory's research projects, related to the work they conduct, or as research assistants.

The following faculty members of the **University of Chicago** will retire with emeritus status this year: **Louis L. Thurstone**, **Charles F. Grey** distinguished service professor of psychology; **Pierce Butler**, professor of library science; **Hazel Kyrk**, professor of home economics and economics; **Ernest P. Lane**, professor of mathematics; **Grace E. Storm**, assistant professor of education; and **Louise W. Putzke** and **Harris R. Vail**, teachers in the laboratory school.

Columbia University has established a Council on Medical Affairs, of which **John G. Jackson** has been named chairman. The council will be limited to 30 members and is intended to be broadly representative of business and professional groups throughout the nation. It will advise and assist the university in the discharge of its public responsibilities and in the development of its medical program. The Division of Cooperative Research, important link between the new Engineering Center and industry, has been put in charge of **John G. Dean**, of International Nickel Co.

Ernest Whitworth has been appointed director of the **Commission on Accreditation of Service Experiences** by the American Council on Education. Chief function of the commission is to evaluate, in educational terms, training given by the armed forces and to recommend to civilian educational institutions the

amount and type of academic credit for each training program. Mr. Whitworth, associate registrar and director of the Office of Machine Records at Cornell, succeeds Charles W. McLane who, at the termination of a year's leave of absence, has returned to the University of Missouri.

A Committee on Institutional Research Policy has been appointed by the American Council on Education, to study the problems arising from the impact on colleges and universities of the expanding research programs sponsored by government agencies and by industry. The nine members of the committee, of which Virgil Hancher, of Iowa State, is chairman are: J. R. Killian, Jr., Franklin D. Murphy, T. P. Wright, J. C. Morris, Larry R. Lunden, James H. Corley, Robert F. Bacher, and James B. Macelwane.

Duke Hospital has opened a new speech service for harelip and cleft palate children of North Carolina. Under the direction of Murray M. Halfond, six children are attending a six-week summer session, arranged by the Social Service Department in co-operation with state agencies. At the end of the course, the children will have learned enough to carry on further work at home and will return to the hospital for periodic checkups.

A Graduate Institute in Silicate Chemistry and Related Sciences has been established under the sponsorship of the University of Toledo, Libbey-Owens-Ford Glass Co., Owens-Illinois Glass Co., and Owens-Corning Fiberglas Corp. Initial financing will be by grants totaling \$75,000 from the industry and \$50,000 from the university over a five-year period. Wilhelm Eitel, of the Office of Naval Research, has been appointed professor of silicate chemistry and director of the institute.

Illinois Institute of Technology will retire four faculty members at the end of the 1951-52 academic year. They are David P. Boder (psychology), Lester R. Ford (mathematics), Charles A. Nash (electrical engineering), and Roe L. Stevens (bridge and structural engineering).

The University of Tennessee has appointed Anton de S. Brasunas, of Oak Ridge National Laboratory, to the staff of the Department of Chemical Engineering, where he will continue his studies on high temperature metallurgy. Robert Kieber, who has been doing research at the Camp Detrick laboratories of the Army, will take over the direction of the Tennessee program of microbiology as related to chemical engineering. He will succeed Arthur L. Pollard, who will retire in September.

Women's Medical College of Pennsylvania has appointed Nicholas B. Dryer, of the University of Vermont, professor of pharmacology and toxicology; Carmen Thomas, director of oncology; Jean Crump, professor of pediatrics and chairman of the department; Katharine R. Boucot, professor of preventive medicine; Emilie S. Loeffler, teaching fellow in the

Department of Medicine; and John B. Levan, clinical assistant professor in medicine. The following have been elected to emeritus status: Emily Bacon, Eunice Stockwell, and Sarah I. Morris.

Grants and Fellowships

American Heart Association awards for 1952-53 amount to more than \$350,000 and will support investigations at institutions in 20 states, the District of Columbia, Montreal, and Beirut. The Marine Biological Laboratory at Woods Hole received \$10,000 for a study of the mechanism of muscular contraction, to be conducted by Albert Szent-Gyorgyi, and the University of Pennsylvania School of Medicine, \$10,500 for work on cholesterol and the action of hormones in relation to this and other fatty substances.

Carnegie Corporation of New York has awarded \$150,000 to Case Institute of Technology to aid in the development of an experimental program for liberalizing engineering education. Begun three years ago, the program seeks to prepare the student for the responsibilities of American citizenship, increase his knowledge of Western culture, develop his reading skills, and teach him to write and speak proficiently.

Central Scientific Company has awarded its annual Cenco scholarships for 1952-53 to Albert J. Rothman, Department of Chemistry, University of California, Berkeley, and to William F. Miller, Department of Physics, Purdue.

Continental Can Company, Chicago, has established a full tuition scholarship in food engineering at Illinois Institute of Technology for 1952-53. In addition, the company has made funds available for special food engineering equipment needed to train students in the field.

The Field Foundation has allocated \$26,000, for two years, to be used in the study of children with psychosomatic problems. A 12-bed unit has been opened by the University of Illinois at the Illinois Neuropsychiatric Institute. Margaret Garard and Julius B. Richmond will direct the studies, and the ward will be staffed by personnel from various departments, to provide an interdisciplinary approach to the work.

The Matchette Foundation Prize in Aesthetics (\$500) will be given for the best article in aesthetics or the philosophy of art by an American author during the academic year 1952-53. Included in eligible material will be all theoretical discussions of the arts and related modes of experience and behavior from a philosophical or scientific point of view, including those of psychology and sociology. Historical and critical studies are eligible if they involve questions of general theory. For full information write to the Franklin J. Matchette Foundation, 20 E. 66th St., New York City.

The Damon Runyon Memorial Fund has made can-

cer research grants amounting to \$418,225 to 22 U. S. institutions and to the Radium-Hemmet Institute, Stockholm. The latter received \$5,000 to finance publication of a study on the results of radiotherapy in carcinoma. The Runyon Fund has distributed a total of \$5,407,540 in grants and fellowships in this country and in 13 foreign countries.

In the Laboratories

Beckman Instruments, Inc., has recently moved its Midwest offices to new and larger quarters at 7145 W. Belmont Ave., Chicago. The Chicago branch is under the direction of George Kineaid.

Chemstrand Corporation has recently named David W. Chaney senior group leader in charge of the research section. He was transferred from the plant at Marcus Hook, Pa., where he supervised research on Aerilan. The following have been appointed to the Research and Development Department in Decatur, Ala.: Albert H. Bruner, Leon Hecht, Jr., Edwin L. Lard, Madison L. Marshall, Andrew I. Smith, Edgar D. Smith, and Robert L. Sublett.

Among the research scientists who will work with the regular staff of the **Roscoe B. Jackson Memorial Laboratory** this summer are Hans Gruneberg, of University College, and James M. Tanner, Sherrington School of Physiology, St. Thomas's Hospital, London. Eighteen additional specialists from all parts of the U. S. will also participate in the laboratory's cancer research program this summer.

National Institutes of Health has announced the following appointments: Joseph J. Bunim, of New York University College of Medicine, as chief of clinical studies on rheumatic diseases, and Norman B. McCullough as chief of clinical research at the Microbiological Institute. Both men will conduct their investigations at the new Clinical Center, which will begin studies with patients next spring.

The **University of Nevada** will study the processing of uranium ores and concentrates, on a laboratory and unit process scale, under a \$60,000 contract with the U. S. Atomic Energy Commission.

Olin Industries, Inc., has organized a Forest Products Division with headquarters in Shreveport, La. The new division will be responsible for the operation of properties in Arkansas, Louisiana, and Texas, recently acquired through merger with Frost Lumber Industries, Incorporated. Major operating personnel are John W. Hanes, F. T. Whited, and Robert H. Evans.

The **Rockefeller Institute for Medical Research** has announced the following promotions: Henry G. Kunkel, Stanford Moore, and William H. Stein, from associate member to member; Vincent G. Alfrey, Werner Hausmann, and Christophe H. W. Hirs, from assistant to associate. New appointments include Richard E. Shope as member; Edward H. Ahrens, Jr.,

Hsiang-Tung Chang, and Carlton C. Hunt, associates; and 12 assistants. Peter K. Olitsky has been made a member emeritus.

Meetings and Elections

The **American Academy of Dental Medicine** installed Harold R. Gelhaar as president for 1952-53. Also elected at the annual meeting in Montreal were Alvin H. Berman, president-elect; William Greenhut, secretary (re-elected); and George C. Stewart, treasurer. The academy admitted two new sections, Philadelphia and Baltimore.

The **American Electroencephalographic Society** has elected Robert B. Aird president, John A. Abbott secretary, and Charles E. Henry treasurer. Mary A. B. Brazier is president-elect.

At the annual meeting of the **American Institute of Electrical Engineers**, Donald A. Quarles was elected president, and William S. Hill, M. D. Hooven, W. L. Cassell, C. Myron Lytle, and Thomas Ingledow were elected vice presidents. N. S. Hibshman was elected treasurer, and Andrew C. Muir, N. C. Pearey, and C. S. Purnell were elected directors.

The Pacific Section of the **American Society of Limnology and Oceanography** held its annual meeting at Oregon State College in June, electing the following officers: president, C. A. Barnes; vice president, W. M. Cameron; secretary-treasurer (two years), G. L. Pickard; member-at-large (two years), E. C. LaFond. Twenty papers were presented in the various symposia that featured the two-day meeting.

The **American Society for Testing Materials** elected Harold Lee Maxwell president and Norman L. Mochel vice president at its annual meeting in New York. The following were elected to the Board of Directors for three-year terms: George R. Gohn, William H. Lutz, Howard K. Nason, Adolph O. Schaefer, and Myron A. Swayze. During the annual meeting the following awards for outstanding technical papers were given: the Charles B. Dudley Medal to Norman W. McLeod, the Richard L. Templin Award to Thomas J. Dolan, and the Sanford E. Thompson Award to H. F. Gonnerman and William Lereh.

The **Association of Research Directors** has elected the following officers: past president, W. Glen Bywater; president, Emil Ott; vice president, Allan R. A. Beeber; secretary-treasurer, David X. Klein. C. R. Scholz, William H. Lyeon, and Delbert F. Jurgensen were elected councillors.

The following have been elected to the Board of Trustees of the **Committee for Economic Development**, a nonprofit and nonpolitical organization of businessmen and educators devoted to impartial study of national economic problems: James L. Allen, William Balderston, Charles R. Cox, Gordon Gray, George H. Love, and Stanley Marcus.

Miscellaneous

Among recent publications issued by the Department of Scientific & Industrial Research and available from H. M. Stationery Office, London, or British Information Services, 30 Rockefeller Plaza, New York City 20, is a volume on *Servomechanisms*, which contains 17 reports dealing with theory, design, and operation resulting from research carried out under the direction of the Ministry of Supply. Reports of the Road Research Board and the Forest Products Research Board summarize the investigations conducted by these agencies in DSIR during 1950.

Robert J. Hoyle, Jr., mechanical engineer and forester of Auburn, N. Y., has joined the research staff of Timber Engineering Company, affiliate of National Lumber Manufacturers Association.

The University of Missouri Library will furnish, on request, microfilms of the book *Die histochemischen und physiologischen Arbeiten von Friedrich Miescher*, at \$3.50. The book was compiled by Miescher's friends after his death and was published at Leipzig in 1897 by F. C. W. Fogel. It is understood that there are only a few copies available.

Rare chemicals wanted by the Biochemical Products Corp., 305 Broadway, New York City 7, are dimethylene dibromide and dimethylene dichloride.

Recent Deaths

Robert W. Andrews (82), physician and surgeon, Poughkeepsie, N. Y., May 28; **Frank Z. Atran** (67), textile manufacturer and philanthropist, New York, June 11; **William C. Ballard, Jr.** (63), electrical engineer, Ithaca, N. Y., June 11; **S. Eugene Barrera** (51), psychiatrist, Schenectady, N. Y., May 25; **S. Potter Bartley** (62), surgeon, New York, June 10; **Giuseppe Belluzzo** (76), economist and authority on projectiles, Rome, May 22; **Walter W. Birge** (74), of New York, pioneer in the development of rayon, Boston, June 13; **Valeria K. L. Bonham** (—), philanthropist, Riverside, Conn., May 20; **J. Clifton Buck** (85), chemist, Atlantic City, June 13; **Elmer H. Carleton** (83), ophthalmologist, Hanover, N. H., June 1; **David Dasso** (61), engineer, Lima, Peru, May 18; **John Dewey** (92), philosopher, New York, June 1; **Quintin Todd Dickinson** (57), chemical engineer, Bound Brook, N. J., June 1; **Alfred R. L. Dohme** (85), of Sharp & Dohme, Inc., Baltimore, June 10.

William G. Epstein (65), physician and surgeon, Chicago, June 16; **Ifor L. Evans** (55), economist, Aberystwyth, Wales, May 31; **Walter Evans** (53), of Annapolis, Md., president, Westinghouse Radio Stations, Inc., Baltimore, May 28; **H. Quimby Gallupe** (63), surgeon, Waltham, Mass., May 29; **John J. Gilbride** (—), physician and surgeon, Philadelphia, June 11; **Philip E. Haebler** (54), of Montclair, N. J., metallurgist, Port-au-Peck, N. J., June 7; **Arthur P. Hasking** (72), physician, Jersey City, N. J., May 28; **John W. Heckert** (80), educator, Oxford, Ohio, June 6; **R. S. Hill** (82), surgeon, Montgomery, Ala., June

16; **William H. Hoover** (63), president, Anaconda Copper Mining Co., Butte, Mont., June 6; **James C. Irvine** (—), educator and chemist, St. Andrews, Scotland, June 12; **Myles W. Johns** (—), physician and pioneer x-ray expert, Utica, N. Y., June 4; **Marvin F. Jones** (63), otolaryngologist, New York, May 26; **Otto Juliusberger** (85), psychiatrist, New York, June 7.

Max Kahn (79), physician, Cleveland, Ohio, June 2; **Theodore Kaletsky** (55), oral surgeon and educator, New York, May 21; **Luther H. Kice** (67), dermatologist and syphilologist, Garden City, L. I., May 30; **Charles K. King** (84), of Mansfield, Ohio, electrical engineer, Edgartown, Mass., May 30; **Albert D. Lasker** (72), philanthropist, New York, May 30; **John L. Lavan** (61), public health expert, Detroit, May 30; **Andrew C. Lawson** (90), geologist, San Leandro, Calif., June 16; **Louis J. B. Le Bel** (57), dermatologist and syphilologist, Passaic, N. J., May 20; **Frank A. Lorenzo** (73), bone specialist, Punxsutawney, Pa., May 30; **James E. Lough** (81), educator, Fort Worth, Tex., June 3; **Frank R. McCrary** (72), naval aviation pioneer, Oakland, Calif., June 10; **Jerome McCrystle** (—), mining engineer, Wilkes-Barre, Pa., June 16; **Samuel S. Mackeown** (56), electrical engineer, Pasadena, Calif., May 29; **Albert A. Merrill** (77), aeronautical scientist, Los Angeles, June 1; **Henry C. Miller** (—), mineralogist, Durango, Mexico, June 10; **Paul G. Miller** (77), of Winneconne, Wis., educator, Oskosh, Wis., May 21; **Richard H. Miller** (67), surgeon, Boston, June 3; **John W. Mills** (—), biologist, Homestead, Fla., Apr. 16; **Percy E. Mills** (63), electrical engineer, Towaco, N. J., May 27; **Louis L. A. Mowbray** (74), aquarium expert, Hamilton, Bermuda, June 5.

Cecil P. Newman (86), geneticist, Ville La Salle, Quebec, June 3; **John L. Perry** (71), former president, Carnegie-Illinois Steel Corp., Pittsburgh, May 27; **Charles E. Randa** (56), electrical engineer, Roselle, N. J., June 2; **Percy E. Raymond** (72), paleontologist, Cambridge, Mass., May 17; **John C. Reed** (50), mining engineer, Louisville, Ky., June 16; **Clarence Robison** (79), educator, Sequel, Calif., May 21; **Lyman H. Robison** (68), physician, Los Angeles, June 15; **Samuel R. Rosen** (40), psychiatrist, New York, May 24; **Harry R. Standiford** (65), civil engineer, New York, June 1; **John P. Stout** (64), agriculturist, Springfield, Ill., May 21; **May Strang** (—), of Pelham Manor, N. Y., founder of cancer prevention clinics, New York, June 11; **John A. Summers** (73), electrical engineer, Cleveland, June 2; **Aikitsu Tanakadate** (95), geophysicist, Tokyo, May 21; **Norma S. Thompson** (64), former secretary, Rockefeller Foundation, New York, June 12; **Charles R. Toothaker** (79), mineralogist, Philadelphia, May 25; **Bertha Van Hoosen** (89), physician, Romeo, Mich., June 7; **Anna H. Voorhis** (85), gynecologist, Mount Vernon, N. Y., June 9; **Herbert Walker** (74), sugar technologist, Manila, June 12; **James L. Walsh** (67), of Summit, N. J., former president, American Ordnance Association, Washington, D. C., June 11.

Technical Papers

Conjugation in *Tetrahymena*¹

Alfred M. Elliott and David L. Nanney

Department of Zoology, University of Michigan, Ann Arbor

Ten wild strains of *Tetrahymena* sp. have been derived from single cell isolations, and in all of them conjugation occurs readily within each clone. Following isolation from various natural sources near Ann Arbor, Mich., the cells were grown in a medium of boiled and filtered Cerophyll (1.5 g/l) which had been inoculated the previous day with *Aerobacter aerogenes*. Conjugation occurs consistently soon after the nutrient medium has been exhausted. Seven of the ten strains have been established in chemically defined media.

During conjugation the cells are attached only at their oral surfaces, though temporary attachments may occur elsewhere. Since the oral surface is near the anterior end of the cell, the conjugating pairs characteristically flare at a wide angle (Fig. 1). In



FIG. 1.

¹Waldo Ferguson has tentatively identified these organisms as previously undescribed species of the genus *Tetrahymena*. His observations have been confirmed, by Corliss, who in a preliminary morphological study, cautions, however, that differences between this ciliate and the type species of the genus are so slight that discovery of intermediate forms may make inadvisable their separation into two species.



FIG. 2.

cultures in which most of the cells are conjugating, the union of three cells is often observed (Fig. 2). In this case the three cells are firmly attached by their oral surfaces. Preliminary observations would indicate that tripolar fertilization takes place, but genetic proof would be necessary to establish this conclusion. The details of the conjugation process and some of the interstock variations will be presented in a later paper. The general features of the conjugation process resemble those reported by Maupas (1) for *Leucophrys patula*.

Observations thus far indicate that conjugation within a clone results in death of the conjugants. Following an exchange of nuclei, the cells fail to separate, and after a number of hours coalesce, become vacuolated, and finally lyse. Attempts are now being made to find conditions under which the conjugants will survive. It has not yet been determined whether conjugation between cells of different origin also results in death, or indeed whether such conjugations occur.

Repeated attempts by one of the authors (A. M. E.) to observe conjugation during the past 19 years with a particular bacteria-free strain of *Tetrahymena geleii* (E) have uniformly met with failure. Mixing various bacteria-free strains (E, W, GL, H) and fixing them at 30-sec intervals over the entire growth period (6

days) showed no evidence for conjugation or other types of nuclear reorganization. Bacterizing the same cultures and mixing them in all combinations have yielded negative results. This failure to obtain conjugation in the long-maintained laboratory strains may be related to the fact that none of these strains now possesses micronuclei. Recent examination of slides of Strain E prepared at intervals for many years has shown that this strain has not possessed micronuclei since 1936, though it may have had micronuclei in 1932 soon after it was isolated from nature. All the newly isolated wild cultures in which conjugation was observed have micronuclei.

The use of animal cells for biochemical genetic studies has been greatly retarded by the difficulty of maintaining cultures in a defined medium. *Tetrahymena* is one of the few animal cells that can be grown on a defined medium (2, 3) and, hence, would be uniquely suited for such studies if crossbreeding analysis were possible. Obtaining conjugation regularly may be considered the first step in preparing this organism for increased use in the laboratory.

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Some Oxidation Products of DL- α -Tocopherol Obtained with Ferric Chloride

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Basic Cotton Research Laboratory, The Plant Research Institute, The Clayton Foundation for Research, and The Department of Chemistry, The University of Texas, Austin

Interest in the products obtained upon the mild oxidation of the tocopherols is aroused in a consideration of their fate during the development of oxidative rancidity in vegetable oils, in which they occur, and in consideration of their possible role in muscle metabolism.

This communication is to record the isolation of five products, four colored oils and a colorless wax, formed upon the oxidation of DL- α -tocopherol with ferric chloride in methyl alcohol. Some of these same products are also obtained when gold chloride is used as the oxidizing agent. (Ferric and gold chlorides are used in the more popular methods for tocopherol assay [1, 2], and their usefulness for this purpose is based on the fact that the chief product obtained at room temperature with both these salts is the well-known tocoquinone [3].)

The oxidation products were resolved chromatographically on a zinc carbonate column when the chromatogram was developed with petroleum ether (b. 60°-75°). The bands, in descending order, were blue-gray, purple, orange, and yellow in color, and the colorless wax was found in the effluent liquid; when the chromatogram was developed with diethyl

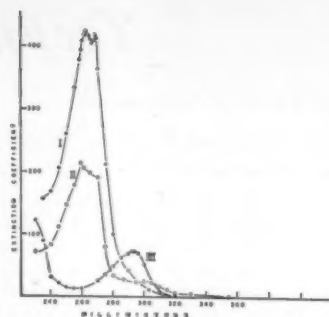


FIG. 1. Ultraviolet absorption spectra for the yellow tocoquinone (I), the red ortho quinone (II), and for DL- α -tocopherol. The ordinate is $E_{1\text{ cm}}^{1\%}$, and the abscissa is in mμ.

ether, the positions of the purple and the blue-gray bands were reversed. The relative proportion of each product formed is a function of the conditions under which the oxidation was carried out; when the oxidation was carried out for 3 hr with ferric chloride in great excess, and at 50° in methyl alcohol, the yields, in the order given above, were 14.5, 32.5, 42.0, 10.4 and 0.5%.

Purification of the oils and the wax was effected through chromatographic fractionation with different columns and different developing solvents, and the fractionation was continued until the extinction coefficients, in methyl alcohol solution, for characteristic absorption bands for each product in the ultraviolet region of the spectrum became and remained constant. The ultraviolet absorption spectra for the yellow and orange products, in methyl alcohol, as well as that for DL- α -tocopherol, are recorded in Fig. 1.

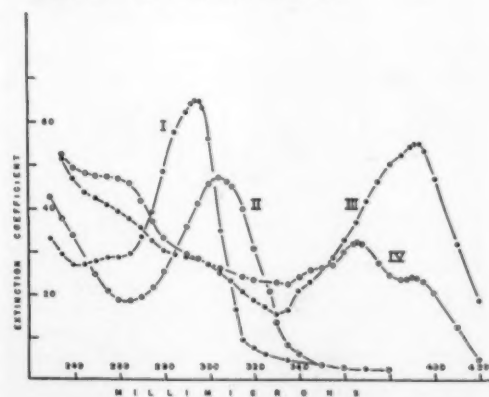


FIG. 2. The ultraviolet absorption spectra for (I) the acid form and (II) the basic form of the purple oil and for (III) the acid and (IV) the basic form of the blue-gray oil. The ordinate is $E_{1\text{ cm}}^{1\%}$, and the abscissa is in mμ.

Both the blue-gray and purple oils have indicator properties, being blue-gray and purple, respectively,

in alkaline media and yellow in acid media. The color change with the purple oil, serving as an indicator in aqueous acidimetric titrations, occurs in the pH range 3.8 to 4.4; the color is yellow at pH 3.8, pink at 4.0, and purple at pH 4.4. The color transition with the blue-gray oil, in methyl alcohol, occurs at an apparent pH of 8.8 to 9.2. The ultraviolet absorption spectra for both forms of each of these indicators, in methyl alcohol solution, are recorded in Fig. 2.

The orange and yellow oils and the yellow forms of the purple and blue-gray oils all show a green fluorescence in ultraviolet light.

Although proofs of structure of these products will be reported elsewhere, it may be stated here that the evidence is that the purple and blue-gray oils are hydroxy paraquinones, the chroman ring in the tocopherol molecule has been ruptured in the case of the purple oil, that the orange is an ortho quinone, and that, with the exception of the yellow product, which is the well-known tocoquinone, the production of the quinones involved the elimination of methyl groups on the aromatic ring of the tocopherol molecule.

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An Egg Encrusted with Protoporphyrin

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The egg shown in the accompanying illustrations was found by a farmer's wife in the oviduct of a hen being prepared for the table. Fortunately it was saved and eventually turned in to one of us for an explanation of its nature and origin. The voluminous literature on abnormal eggs was reviewed by Davaine (1) in 1860, and again recently by Romanoff and Romanoff (2), but neither in these compilations nor elsewhere have we been able to find any record of an egg like this one. A brief report therefore seems desirable.

When received, some three weeks after its discovery, the egg was completely covered with a rough, granular, dark purplish-brown material. The coating was smoothest around the middle and was rough and pebbled at both ends. The egg measured 6.54 x 4.69 cm and weighed 70 g. When shaken, it sounded like an addled one.

Inquiry revealed that it had been removed from the uterine region of the oviduct of a 4-year-old hen, a hybrid from the cross Barred Rock ♀ x Rhode Island Red ♂. The hen had been a good layer and was in good health when killed for the table about Oct. 1, 1951. Because of the age of the hen and the season of

¹ We wish to thank Arley Bever for determining the location of the three absorption bands.

the year, one would expect the ovary to be inactive at that time. The owner reported that the only other eggs in the hen were small follicles, attached to the ovary. When freshly removed, the abnormal egg was more purple in color than it appeared after drying.

Contents of the egg were carefully blown out by A. A. Allen. On drilling the hole, nothing could be blown out until water was forced in through the blow-pipe. The first material to come out was yellow and caseous. Eventually, by blowing in water and air alternately, the contents were removed. No bad odor was noticeable.

The soaking necessary to blow out the egg loosened the pigmented coat, which cracked in many places as



FIG. 1. The encrusted egg, showing cracks that developed in the crust after it was blown and dried out. The white spot at the top shows the underlying shell where a fragment of the crust was removed.

it dried (Fig. 1). It became clear that under the dark encrustation there was a light-colored eggshell, calcareous in nature and apparently normal. Overlying it, the dark material formed a discrete crust composed of two layers (Fig. 2). The inner of these was dense, almost glassy, and about 1 mm thick. The outer layer was thinner and less dense. The average thickness of the crust, including both layers, was 1.6 mm.

Because the hen was derived from two breeds that normally lay brown-shelled eggs, it was suspected that the crust might be composed of protoporphyrin, the pigment causing the brown color of the shell in the eggs of many birds (3). Chemical tests by one of us (J. B. S.) verified this assumption. The amount of iron was only 0.007%, which showed that hemoglobin was not present, and hence that there was no blood in the crust. Fragments of the crust were finally dissolved in 25% HCl. When the insoluble material was



FIG. 2. Larger end of the egg, with parts of the crust removed and others showing its two layers. The fragment turned over shows the smooth undersurface of the dense inner layer.

centrifuged down, it had a slightly green color and the supernatant solution was faintly pink. It gave a strong red fluorescence with ultraviolet light, and spectrophotometric analysis with a Beckman quartz spectrophotometer showed that the absorption bands were located at 600, 557, and 407 m μ . These figures agree with those given for protoporphyrin by Lemberg and Legge (4). It was concluded that the brown pigment was that substance, probably contaminated with protein and calcium carbonate.

The surface area of the egg, as calculated from four different formulas (2), was estimated to be between 78 and 85 cm². Taking the average area of 82.9 cm² and the average weight of the air-dried crust as 144.8 mg/cm² (av of two determinations), it was calculated that the total amount of the encrusting material was a little over 12 g. Although this figure is only an estimate, it seems probable that such an egg would have been considerably more useful to Fischer and Kögl (3) than the 300 gulls' eggs from the shells of which they managed to extract for their analyses 30 mg of the crystalline dimethylester of "oöporphyrin."

This egg must have been retained for several weeks in the uterus of the hen's oviduct. This is attested not only by its amazing accumulation of protoporphyrin, but also by the caseous state of the contents. Eggs with fully formed shells that are not laid when they should be are sometimes returned up the oviduct and dropped into the body cavity. Others return until they meet an outbound yolk and then return to the uterus with that yolk, the whole being eventually laid as a double egg, or *ovum in ovo*. The unduly thick shells of some of these enclosed eggs indicate that they have been held overlong in the uterus (5). In the present case, the uterus of the unfortunate hen was unable either to expel the egg or to send it back whence it had come. It is interesting to note that, in this abnormal situation, the deposition of shell was eventually stopped, or greatly reduced, whereas the deposition of shell pigment continued.

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The Accelerating Effect of Calcium on the Fibrinogen-Fibrin Transformation¹

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The anticoagulant effect of ethylenediamine tetraacetic acid was first investigated by Dyckerhoff *et al.* (1). This substance by its powerful deionizing property binds the calcium ions involved in blood coagulation. Investigating the action of ethylenediamine tetraacetic acid, or EDTA, on the coagulant action of snake venom on plasma and fibrinogen (results of these experiments will be published in another paper), we found that the action of EDTA is not only involved in the first but also in the second phase of blood coagulation; i.e., this substance hinders the fibrinogen-fibrin transition. This impediment is related to the time of incubation of the fibrinogen solution with EDTA.

Table 1 shows how the clotting time increases when fibrinogen is incubated with different amounts of EDTA for various lengths of time.

This inhibiting effect is not due to a possible alteration of pH by EDTA, since no significant change in pH was found when fibrinogen was incubated with EDTA in concentrations varying between 0.1 and 1.0 mg/ml. The inhibiting effect must be a direct one on the fibrinogen-fibrin transformation, since no prothrombin contamination was detected in the fibrinogen preparations.

Neither can the increase in clotting time be due to destruction of fibrinogen, for, as Table 2 shows, the amount of clot is the same irrespective of the magnitude of inhibition.

Since EDTA is a powerful binder of calcium it was concluded that the inhibition is due to the removal of calcium. The experiments in Table 3 show that the inhibiting effect of EDTA can be completely reversed by the addition of calcium, thus strongly indicating that the inhibiting effect is due to the binding of calcium.

It has been found by Laki and Lóránd (2) that calcium plays a part in the fibrinogen-fibrin transition.

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² The authors would like to thank Rocha e Silva (Instituto Biológico, São Paulo) for the EDTA sample, Armour & Co., Chicago, for the bovine fibrinogen, and Parke, Davis & Co. do Brasil for the thrombin used in the experiments.

TABLE 1

CLOTTING TIME OF FIBRINOGEN AFTER INCUBATION WITH EDTA-DISODIUM

Incubation time (min) at 37° C	Concentration of EDTA in mg/ml		
	0.10	0.25	0.50
	Clotting time (sec)		
1	21	20	21
5	21	36	44
10	23	58	67
20	22	85	83
40	—	99	99

tion. The clot formed in the presence of calcium was found to be insoluble in urea. The work of Lóránd (3) and Ferry, Miller, and Shulman (4) further emphasizes the role of calcium in altering the rigidity of the clot.

Our experiments furnish additional evidence of the important role of calcium in the clotting of fibrinogen and show that calcium has an accelerating effect on this process either alone or as a component of a hitherto unidentified factor. Our experiments also

TABLE 2

WEIGHT OF FIBRIN CLOTS FORMED IN THE PRESENCE OF EDTA-DISODIUM

	Concentration of EDTA-disodium in mg/ml				
	2.0	1.0	0.5	0.25	0
	Weight of fibrin clot in mg/cc				
Without calcium	6.0	5.9	6.4	6.2	6.2
With calcium equivalent to EDTA	5.9	6.2	6.0	6.1	6.3

point out the possibility that in the speed of clotting of blood the described role of calcium might be involved.

The fibrinogen solutions used in our experiments contained 2-6 mg/ml clottable protein and 5% imidazole buffer of pH 7.24 and were prepared from

TABLE 3

CLOTTING TIME OF FIBRINOGEN INCUBATED WITH EDTA-DISODIUM CLOTTED WITH NORMAL AND CaCl_2 CONTAINING THROMBIN

Concentration of EDTA in mg/ml	Clotting time (sec)		
	Thrombin (normal)	Thrombin with 0.004 M CaCl_2	Thrombin with 0.008 M CaCl_2
0.0	19	18	18
0.1	48	22	19
0.3	200	31	20
0.5	210	35	25
0.7	200	150	28
1.0	215	145	85

bovine fibrinogen; the thrombin solutions were prepared from tropical thrombin. The contents of one vial were dissolved in 25 ml glycerol and 25 ml saline. We diluted this stock solution to about 20-25 u/ml for our experiments.

The EDTA-disodium salt was prepared from ethylenediamine tetraacetic acid (DPI, Eastman Kodak, Rochester, N. Y.). The clotting times were tested by applying the somewhat modified method recently described by Laki (5). We used spot test plates made of Plexiglass put in a constant temperature water bath of 37° C. To 0.2 ml fibrinogen 0.1 ml thrombin was added, and the clotting time checked by a stop watch. The fibrinogen determinations were carried out as described by Laki (6).

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Enzymatic Cytolysis of Epithelium by Filtrates of Feces from Patients with Ulcerative Colitis¹Richard B. Stoughton²

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Filtrates of feces from patients with ulcerative colitis contain a factor which has a disintegrating effect upon human epithelium. Fixed sections of human skin and bowel incubated with this factor display loss of intercellular bridges of epidermal cells (acantholysis) and loss of cytoplasmic substance of cells of both skin and intestinal mucosa. To date, this factor has been found only in feces from patients with ulcerative colitis.

Preparation of the active filtrate and the method for producing cytolysis are as follows: 100 g of fresh feces from patients with ulcerative colitis are well blended with 300 ml ice-cold M/10 phosphate buffer, pH 7.4, and centrifuged. The supernatant fluid is passed through a Seitz filter and collected in an ice-cold flask. The filtrate is then applied to formalin-fixed sections of normal human skin or bowel at 37° C for 30-120 min. The sections are washed in distilled water and stained with hematoxylin and eosin. The active factor is quite labile; it is destroyed in a few hours while standing at room temperature, more slowly at 4° C (1-4 days), but is preserved for over a month in the frozen state.

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² The author is indebted to Stephen Rothman for valuable advice in carrying out the experiments and in preparing this manuscript.

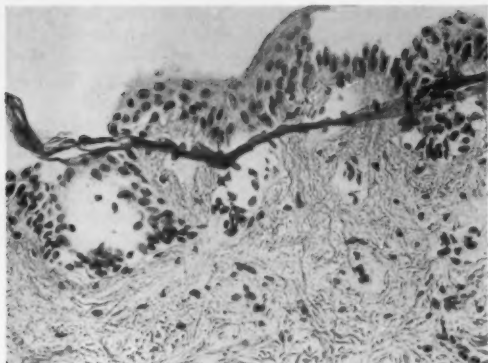


FIG. 1. Human skin after cytolysis by fecal filtrate showing *in vitro* "blister" formation and separation of epidermal cells. The separated horny layer lies across the section. $\times 225$.

In order of appearance, the following changes are observed in and between the epidermal cells (Fig. 1): (1) disintegration of intercellular bridges; (2) loss of eosinophilia of cytoplasm; (3) rents in the epidermis, with "blister" formation; (4) detachment of

cells from each other; and (5) swelling and loss of basophilism of nuclei.

The epithelial cells of large bowel lose most of their cytoplasm, leaving relatively normal nuclei (Fig. 2).

The cytolytic factor is most active in *M/10* phosphate buffer in the pH range 7.2 to 7.8; it is inactive in *M/10* phosphate buffer below pH 6.4. The factor is destroyed by heating for 10 min at 56° C and is non-dialyzable. It is inactivated by human serum, CN^- , Hg^{++} , and Ag^+ . Also, suramin sodium and Treburon,³ both sulfated compounds, are potent inhibitors of this factor.

On the basis of these observations it is assumed that this cytolysis is an enzymatic process. It is not yet known whether the cytolytic factor derives from microorganisms, tissue breakdown, or digestive enzymes.

The following proteolytic and mucolytic enzymes were added to heat-inactivated ulcerative colitis fecal filtrates and incubated with formalin-fixed sections: trypsin (crystalline),⁴ chymotrypsin (crystalline),⁴ papain, fibrinolysin, lysozyme, ribonuclease, desoxy-

³ Trade-mark of sodium salt of sulfated polygalacturonic acid methyl ester methyl glycoside. Supplied by Hoffman-LaRoche, Inc., Nutley, N. J.

⁴ Worthington Biochemical Sales Co., Freehold, N. J.



A



B

FIG. 2 A, human intestinal mucosa after incubation with heat-inactivated fecal filtrate. $\times 100$. B, section from same block as A. Human intestinal mucosa after incubation with active fecal filtrate showing almost complete cytolysis of epithelium. $\times 100$.

ribonuclease,⁴ pectinol,⁵ and *Cl. Welchii* type A filtrate.⁶ None of these produced acantholysis or separation of epidermal cells. Trypsin in high concentration (100 mg/cc), caused a minimal loss of eosinophilia in the cytoplasm of bowel epithelium.

All these findings refer only to the effect on formalin-fixed sections. After fixation in formalin, tissues were dehydrated, cleared, and embedded in paraffin in the usual laboratory routine. Sections were rehydrated and washed in water before filtrates were applied. If acetone-fixed sections are used as test objects, it is found that the stool filtrates contain a trypsinlike cytolytic factor which, however, clearly differs from the first factor. It is much more stable, is not inhibited by Treburon or suramin sodium, and does not break down intestinal epithelium.

Mild *in vitro* cytolysis resulting from treatment with fecal filtrates yields histologic pictures very similar to that of pemphigus vulgaris. In this fatal, blister-forming disease, the primary histologic change is destruction of intercellular bridges, blister formation being secondary to the acantholysis (1-4). Also, some phases of the cytolysis by fecal filtrates are morphologically similar to those described in experimental burns (5). It might be worth while to mention that sulfated compounds such as naphuride and Treburon, which inhibit the cytolysis *in vitro*, give promise of being effective in the symptomatic treatment of pemphigus.

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* Supplied by Rohm & Haas Co., Philadelphia, Pa.

* Supplied by Lederle Laboratories, Pearl River, N. Y.

Effect of *p*-Chlorophenoxyacetic Acid (CIPA) and 3-Indolacetic Acid (IA) on Certain Dehydrogenase Systems of the Tomato Fruit, *L. esculentum*¹

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The plant growth regulator *p*-chlorophenoxyacetic acid (CIPA) applied in aqueous solution to flower clusters of the tomato increases the percentage of fruit set and stimulates the development of the tomato fruit. Hsiang (1) has shown that stimulation of growth in the orchid flower is usually preceded by an increase in catalase activity and oxygen uptake. The effect of auxins in stimulating growth and respiration

¹ Journal Series Paper No. 1295, approved by the director of the Missouri Agricultural Experiment Station.

in plants has been attributed to the protection of various dehydrogenase enzyme systems against some natural inhibitor (2). The interrelationships between the dehydrogenase enzymes, respiration, and growth have been pointed out by Commoner and Thimann in studies on auxin-treated *Avena* coleoptiles (3), and by Berger and Avery (4-6). A study of the dehydrogenase enzymes of the tomato fruit may provide information on the mechanism of growth stimulation.

It has been pointed out by several workers that hormone treatment as an aid to fruit set of greenhouse-grown tomatoes is most effective when applied during the post-pollination period (7, 8). In the present investigation treatment of hand-pollinated fruits was made 6 days after pollination. The optimum concentration of CIPA when used as a flower spray was found by Murneek and co-workers (7, 8) to vary between 5 and 25 ppm, depending on weather conditions. In order to insure the same age, individual fruits of the cluster were treated by dipping in aqueous solutions of CIPA. When this method was used the concentrations of CIPA had to be increased approximately forty times that used with the flower spraying method. Responses in fruit set and development were obtained with 200, 1000, and 2000 ppm CIPA similar to those obtained using flower sprays of 5, 25, and 50 ppm.

TABLE 1

MICROGRAMS OF TRIPHENYLFORMAZAN PRODUCED BY DEHYDROGENASE SYSTEMS IN 1 ML TOMATO HOMOGENATE INCUBATED 20 HR AT 38° C FROM FRUITS TREATED WITH 0, 200, 1000, AND 2000 PPM *p*-CHLOROPHENOXYACETIC ACID (CIPA). TESTED 28 DAYS AFTER TREATMENT

Substrate	Control	Concentration CIPA		
		200 ppm	1000 ppm	2000 ppm
	Triphenylformazan (in µg)			
Glutamate	406	340	260	123
Succinate	280	215	191	173
Fumarate	197	360	444	127
Malate	145	127	460	150

Dehydrogenase activity was measured by the reduction of 2,3,5-triphenyltetrazolium chloride (TTC) in the presence of various substrates. The method used was that of Kun and Abood (9) as modified by Isenberg *et al.* (10) for plant tissue. Ten per cent fresh tissue homogenates were prepared, using a glass homogenizer. The principal substrates were 0.2 M solutions of sodium succinate, sodium fumarate, sodium malate, and sodium glutamate with pH adjusted to 7.4. Other substrates were included in the study, but the above four gave the most consistent and reproducible results and will be the only ones reported on here. The reaction tubes contained 0.5 ml of 0.2 M monopotassium phosphate buffer pH 7.4, 0.5 ml substrate, 1 ml 10% tissue homogenate, and 1 ml 0.1%

solution TTC. The reaction mixtures were incubated in a 38° C oven for 20 hr. After removal from the oven, 7 ml of acetone was added to each tube to dissolve the formazan and precipitate the homogenized tissue. The tubes were then centrifuged to remove the ppt, and the clear supernatant was read in an Aminco colorimeter at 420 mμ. A blank homogenate heated to 82° C produced no formazan and was used as the 0 standard. A standard curve was prepared using 100, 200, 400, and 600 μg of triphenylformazan in acetone. The results presented in Table 1 are for samples collected 28 days after treatment, each value being an average of three determinations. The quantity of triphenylformazan produced in the presence of the four substrates is in terms of μg in 20 hr at 38° C.

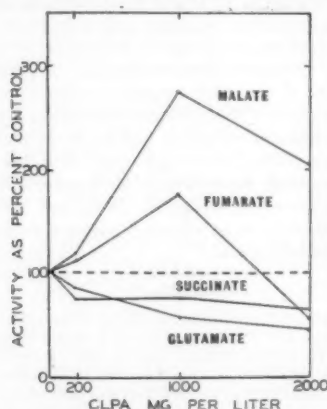


FIG. 1. Dehydrogenase activity of homogenates of tomato fruits. Samples 28 days after treatment with 0, 200, 1000, and 2000 ppm CIPA.

Under the conditions of this study the optimal concentration of CIPA for fruit set and stimulation of fruit development was 1000 ppm. This concentration also resulted in an increased reduction of TTC in the presence of malate and fumarate. At this same concentration the reduction of TTC with succinate and glutamate as substrates was less than that of the control fruits. The reduction of TTC in the presence of the latter substrates was lower than that of the controls at all concentrations of CIPA employed; however, there was only a slight decrease in activity with increasing concentrations of CIPA. This may be compared with the effect of increasing concentrations of CIPA on the reduction of TTC in the presence of malate and fumarate (Fig. 1).

An application of 200 ppm CIPA to the tomato fruits resulted in only a slight increase in fruit set over that of the controls. The effect of this concentration on dehydrogenase activity, as indicated by reduction of TTC, was also very slight. Increasing the concentration of CIPA applied to the fruits from the optimum of 1000 to 2000 ppm had a conspicuous effect not only on the dehydrogenase activity in the presence of malate and fumarate, but also on the

TABLE 2
MICROGRAMS OF TRIPHENYLFORMAZAN PRODUCED BY DEHYDROGENASE SYSTEMS IN 1 ML TOMATO HOMOGENATE INCUBATED 20 HR AT 38° C. CONTROL HOMOGENATES FROM TABLE 1
TREATED *in vitro* WITH 0, 1, 5, AND 10 μg 3-INDOLACETIC ACID/ML HOMOGENATE

Substrate	Control	Concentration IA		
		1 μg	5 μg	10 μg
		Triphenylformazan (in μg)		
Glutamate	406	330	240	197
Succinate	280	209	210	191
Fumarate	197	222	340	119
Malate	145	173	400	300

development of the tomato fruit. The fruits treated by dipping in 2000 ppm CIPA exhibited many of the undesirable symptoms evident with flower cluster sprays in which the concentration of growth regulator is above the optimum. These symptoms were reduced carpel development, smaller seeds, shrunken or undeveloped placental tissue, and "blossom end rot" of the fruit. The latter is a physiological disease often found under adverse growth conditions and particularly associated with a low or unbalanced water supply.

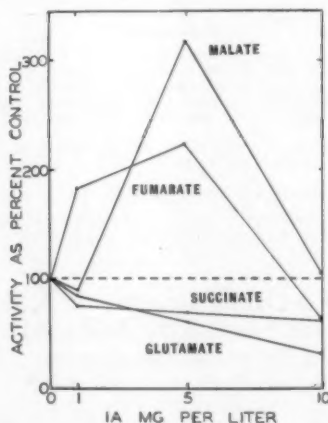


FIG. 2. Dehydrogenase activity of homogenates of tomato fruits; 0, 1, 5, and 10 μg IA added/ml of homogenate prepared from nontreated fruits.

The close association of dehydrogenase activity and growth of the tomato fruit, as affected by treatment with CIPA, prompted an *in vitro* investigation of the effect of growth regulators on dehydrogenase activity. Samples from the collection 28 days after treatment were selected, and 10% homogenates prepared from control fruits. To these homogenates were added 1, 5, and 10 μg 3-indolacetic acid (IA)/ml of homogenate. These amounts were selected to correspond with the ratio of concentrations of CIPA applied to

the fruit in the previous study. With the samples collected at 14 and 21 days after treatment it had been found that 1 μ g IA/ml homogenate gave approximately the same dehydrogenase activity as that from fruits treated with 200 ppm CIPA. The results of this study are presented in Table 2. The control homogenates in this case were the same as those for the CIPA-treated fruits, with aliquots from each replication removed for treatment *in vitro* with IA. The reduction of TTC by the various dehydrogenase systems in the presence of malate, fumarate, succinate, and glutamate when treated with varying amounts of IA *in vitro* corresponds closely to that found when fruits are treated on the plant with proportional amounts of CIPA (Figs. 1 and 2).

The evidence seems to support the hypothesis put forth by Thimann and others (2-6) that the effect of growth regulators of the auxin type is exerted through dehydrogenase enzyme systems. It has recently been pointed out by Brodie and Gots (11) that the actual donor of hydrogen in the reduction of TTC appears to be a flavin enzyme through a dehydrogenase-DPN-flavoprotein system. Since it may be assumed that an enzyme of the flavin type is present in the tomato homogenates, any increase in dehydrogenase activity should be manifested by an increased rate of reduction of TTC, unless, of course, the rate of oxidation of DPN by the flavin enzyme is limiting. At present this does not seem to be the case; however, a further investigation of this aspect is being conducted.

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Carbon—Carbon Bond Lengths

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A method of estimating bond lengths and a system of classifying bonds according to length have recently been outlined (1, 2). The purpose of this paper is to discuss in more detail some specific applications to carbon—carbon bonds.

The existence of separate groups of carbon—carbon bond lengths within the broad limits of about 1.15 to 1.60 Å had previously been pointed out by A. F. Johnson (3).

¹Thanks are due to Jack F. Mills and Wesley W. Wendlandt for assistance in some of the calculations necessary for this work.

Since the earlier work (1, 2), it has seemed preferable to assign somewhat larger "nonpolar covalent radii" to the inert atoms (4). These have resulted in somewhat larger stability ratio (SR) values—e.g., 5.75 for fluorine, 3.79 for carbon, and 3.55 for hydrogen—but the revised values do not affect the bond length calculations significantly, as the interrelationships remain largely unchanged. The revised values, however, are the basis of the work reported here.

TABLE 1
SOME CALCULATED AND OBSERVED C—C BOND
LENGTHS IN FLUOROCARBONS

Compound	R obs (5)	R calc (1)	R obs-R calc
C ₂ F ₆	1.45-0.06	1.40	0.05
	1.52-1.62	1.40	0.12-0.22
C ₂ F ₄ , hexafluoro-propene	1.52	1.40	0.12
C ₄ F ₈ , octafluoro-cyclobutane	1.60-0.04 (6)	1.40	0.20

Single bonds. Most carbon—carbon single bonds are in general quite similar in length and show no unusual characteristics. There are two forms of deviation from "expected" length, however. The first is in molecules wherein two singly linked carbon atoms are each joined to highly electronegative atoms, so that the adjacent carbon atoms must be of like positive charge, in accordance with the stability ratio theory (1), or any theory admitting bond polarity. In such molecules the carbon—carbon bonds are longer than otherwise expected. The second form of deviation is a bond "shortening" when the carbon atoms joined in the single bond are linked to other atoms by multiple bonds.

The first type is illustrated by the fluorocarbons. As shown in Table 1, the reported C—C distances are the same as, or slightly greater than, in paraffin hydrocarbons, whereas according to the stability ratio theory, they should be about 0.14 Å shorter. It is suggested that if the theory is correct in this application, the observed absence of shortening may be chiefly the result of repulsion between the like charged carbon atoms. This should result in weakening of the bond. However, the fluorocarbons are noted for their thermal stability (7). It is suggested that the polarity of the C—F bonds is sufficiently great, and the fluorine atoms are sufficiently close to the carbon atoms next to the carbon atom to which they are attached, that an appreciable electrostatic attractive force is exerted between each positive carbon atom and the negative fluorine atoms that are attached to the next carbon atom. This force would add to the stability of the fluorocarbon molecule, compensating for the loss in stability resulting from carbon—carbon repulsion. One would expect the potential hindrance to free rotation about the C—C bonds in such molecules to be unaffected by this attractive force but increased by repulsion among the negative fluorine atoms attached to adjacent carbon atoms. This hindrance has been

determined as 4350 cal/mole for hexafluoroethane, C_2F_6 (8), compared to 3000 cal/mole for ethane (9).

Illustrating the shorter-than-expected bonds are single bonds between two double-bonded carbon atoms, which are classified as type IIa (1), being 0.923 times the normal single bond in length. The only examples reported are 1,3-butadiene and cyclopentadiene. An equivalent single bond should be that between an olefinic carbon and a ring carbon in stilbene (1,2-diphenylethylene); this bond is in the same class. The calculated-reported bond lengths in these molecules are 1.44-1.47 (5), 1.44-1.46 (5), and 1.44-1.44 Å (10).

Single bonds to triple-bonded carbon are of the same type, as evidenced by 14 different reported examples (1). Single bonds between two triple-bonded carbons, however, are still shorter, being classified as IIb (1), using the factor 0.885 times the normal single bond length. The only three examples cited in the literature appear to be in hydrocarbons with the structural skeletons $C \equiv C - C \equiv C - C$ and $C \equiv C - C \equiv C$, and in cyanogen, $N \equiv C - C \equiv N$. The calculated-reported (11) bond lengths are 1.38-1.38, 1.38-1.36, and 1.33-1.37 Å.

These types are illustrated by the interesting example of perylene, a hydrocarbon having the skeleton $C \equiv C - C \equiv C - C \equiv C$. The first bond is a single bond to a triple-bonded carbon, and the second is a triple bond, type IVa, for which the factor 0.770 is used. The third, between a double and a triple bond, may be regarded as an average of IIa and IIb. (Similar bonds occur in "tolane," diphenyl acetylene, with lengths calculated on this basis as 1.41, comparable to 1.40 Å reported [10].) The fourth bond of perylene is an ordinary olefinic double bond. The calculated-reported (12) bond lengths are 1.44-1.47, 1.20-1.20, 1.41-1.42, and 1.32-1.35 Å.

A single bond between two double bonds is, then, an average in length of an ordinary single bond and a double bond. Similarly, a single bond between two triple bonds is an average of an ordinary single bond and a triple bond.

Multiple bonds. Carbon-carbon double bonds and carbon-carbon triple bonds are evidently nearly all of the same types, being equal to the single bond length times the factors 0.845 and 0.770. The only reported exceptions are the halogen-substituted derivatives, in which the C-C bond lengths are greater than expected after correction for electronegativity adjustment (1). It is of interest that these molecules are like the fluorocarbons in having adjacent carbon atoms of like charge. The observed bond "lengthening" may possibly be explained similarly as resulting from repulsion between the like charged carbon atoms.

The bonds in aromatic rings are especially interesting. The ideas described earlier (1) are very useful in providing a simple explanation of the fact that the carbon-carbon distance in benzene is shorter than an average of an ordinary single bond and a double bond. As discussed above, a single bond between two double-bonded carbon atoms is shorter than an ordinary single bond, being of type IIa instead of Ia, and hence

TABLE 2
CARBON-CARBON BONDS, FACTORS, AND LENGTHS

Bond type	Factor (1-0.0385n)	n	Length, if calc single bond is 1.52-1.58 Å
Ia Ordinary single	1.000	0	1.52-1.58
IIa Single between two doubles	0.923	2	1.40-1.46
Single to triple			
(Graphite)	0.885	3	1.35-1.40
IIb Single between two triples			
Aromatic ring	0.845	4	1.29-1.34
IIIa Double			
IVa Triple	0.770	6	1.17-1.22

only 0.923 as long. Since the bonds in a benzene ring are all alike, their length should be the average of IIa and IIIa, not Ia and IIIa. The factor is then 0.885 (which, incidentally, also represents the average of a triple bond and an ordinary single bond). The Ia bond length in benzene is 1.58 Å, and 1.58×0.885 is 1.40, comparable to the reported (13) bond length of 1.39 Å. The higher-than-expected bond energy is of course consistent with the shorter length. The C-C distances in pyridine and pyrazine, as well as for phenyl compounds, in all 15 examples reported in the literature (5), are in the same length class as those of benzene.

With the exception of bonds between atoms of considerable like charge, which are expected to be longer, one may then estimate the carbon-carbon distance in any organic molecule, preferably in the vapor phase, as the product of the calculated single bond length (1) and a factor, as summarized in Table 2. The more important significance of this work seems to arise not from the method of deriving the factors (1), which was of necessity oversimplified, but from the very existence of such factors, by which the several bond lengths, within the limits of experimental error, appear to indicate definite bond types, which are related simply and definitely.

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Manuscript received January 28, 1952.

Comments and Communications

Geometric Deviations in the Growth of Tissue Cultures¹

THE geometric regularity of radial and interconnecting growth precisely defined by Weiss (SCIENCE, 115, 293 [1952]) and Katzberg (SCIENCE, 114, 431 [1951]) has puzzling exceptions. In roller tube cultures of mouse skin in plasma clots, columns of fibroblastlike cells progress along straight lines, sometimes without visible relation to the centers of growth.

In good observance of the rules, a cord of fibroblasts (Fig. 1, upper left) aligns the centers of two

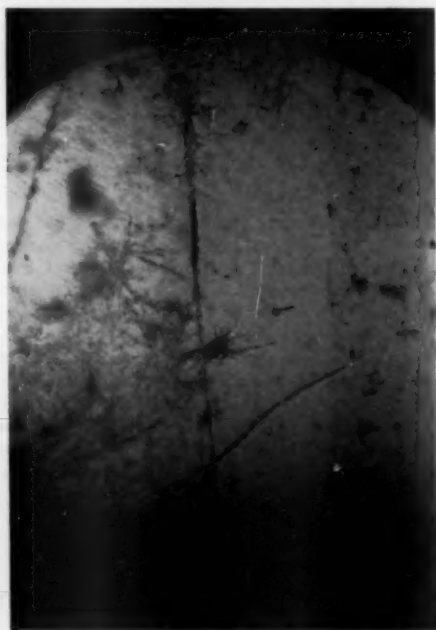


FIG. 1.

explants and another line (lower right) progresses outward along a radius. The long radial column from the upper explant, however, has continued at a tangent past the lower.

In Fig. 2, three columns of growth extend parallel to one another, but at an angle to the path of loose growth connecting the adjacent explant in the upper left part of the field. The columns are crossed almost at right angles by a branch of the column at the left. Intersecting radii have also been observed. Columns sometimes cross in the same optical plane. The divergent lines of growth do not coincide with any axis

¹This work was supported in part by a research grant from the National Cancer Institute, National Institutes of Health, USPHS, and by an institutional grant from the American Cancer Society.



FIG. 2.

of the tube or any detectable flaw or obstruction in the clot or vessel.

The writer had intended to delay publication until he developed a formula for tangential growth, but injecting the information into the current surge of interest might prove more fruitful than quiet incubation.

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Migrating Aphids

IN THE winter of 1950-51, and again in 1951-52, there were extensive outbreaks of the green peach aphid, *Myzus persicae* (Sulzer), on tobacco in Puerto Rico. This aphid had never before been reported on this host, and again the question arises as to whether the outbreaks developed from winged adults migrating from infested tobacco plants in the continental United States, or whether a physiologically distinct strain evolved independently in Puerto Rico from the aphids of this species, which are there in abundance but normally infest tomato, Irish potato, eggplant, pepper, and, exceptionally, the green fruit of papaya.

The evidence against migration is strong. The prevailing northeast trade winds could scarcely bring any kind of insect from across the Atlantic, and winds

blowing in the opposite direction are normally at an elevation of somewhat over 10,000 ft. Aphids have been collected at an elevation of 13,000 ft, however (1), and they may possibly occur at even higher elevations. Occasionally, also, winds from the north-west strike Puerto Rico, possibly originating in Florida and Georgia, or even farther west and north in the continental tobacco-growing regions of the U. S. More probably, antitrade winds of local origin may have carried aphids from tobacco-raising areas of Cuba and Hispaniola, for this aphid was definitely reported from the San Juan y Martínez region of Pinar del Río Province, Cuba, for the first time in 1948 (2), and is now present in the Dominican Republic.

The strongest evidence in favor of migration is parallelism with the spread of the spirea aphid, *Aphis spiraeicola* Patch, first noted on citrus in Florida in 1922, becoming a serious pest by 1923 (3), occurring in Cuba by 1924 (4), and intercepted by

S. D. Whitlock on grapefruit at Mayagüez, P. R., on Oct. 23, 1926. This aphid had never before been collected in Puerto Rico and could hardly have been overlooked, for the rosetting it causes on citrus is very conspicuous. By 1945 it was found in numerous localities on the island by José Adsuar on papaya, and subsequently he was able to prove the transmission of papaya mosaic by the green citrus aphid, *Aphis spiraeicola* Patch (5), a disease unknown in Puerto Rico before this aphid appeared.

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Book Reviews

Thermodynamics of Alloys. John Lumsden. London: Institute of Metals, 1952. 384 pp. \$5.50.

The subject of thermodynamics can be applied to a large number of physical phenomena. In *Thermodynamics of Alloys*, Lumsden has focused attention on the application of thermodynamics to the quantitative study of phase equilibria in metals and alloys. Although the generalized concepts and structure of thermodynamics may be found in numerous references, there has been a need for a reference source devoted to the application of thermodynamic potentials to alloy systems. Those engaged in metal science will probably find a place in their libraries for this volume.

The primary objective of the book is to show the reduction of physicochemical measurements to comprehensive free energy equations and how, from this, the equilibrium properties of the system can be calculated. The reader is assumed to be familiar with differential and integral calculus—otherwise, the text is self-sufficient with respect to the thermodynamics necessary for the problems considered. In terms of classical and quantum theory, introductory chapters develop the concepts and mathematical framework necessary for the quantitative application of thermodynamic potentials. The application to such topics as thermal capacity, thermal expansion, compressibility, Poisson's ratio and fusion of pure metals (to name but a few) precede the treatment of alloy systems. The development of free energy equations for alloy systems follows sections in which the experimental estimation of thermodynamic quantities is described. In the closing chapters, the forms of the free energy functions are related through statistical mechanics to atomic interactions. Tabulated functions are included to assist in the calculation of free energy changes.

An admirable organization of the text has been adhered to throughout the book. The thermodynamic concepts required for the application are set forth, after which experimental data for actual cases illustrate the salient points. Several chapters are devoted to the derivation of free energy functions from different types of measurement, and the application of these functions to the equilibria of actual systems including Zn-Sn, Zn-Cd, Zn-Cu. Several other systems are described more briefly. The use of data from experiments of different kinds to estimate the reliability of the thermodynamic calculations is shown in almost all cases.

W. E. TAYLOR

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Scientific Book Register

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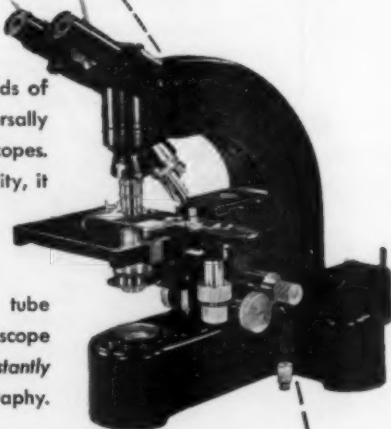


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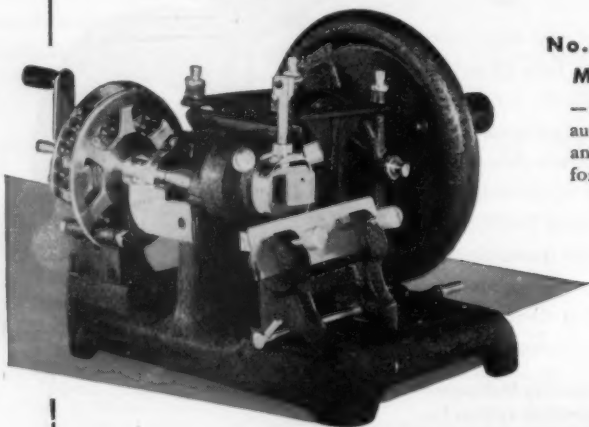


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